

What is claimed is:

- 1 1. A control program development support apparatus
- 2 comprising:
- 3 a control program execution unit for executing
- 4 a control program, which controls an operation of a
- 5 mechanism, to calculate and output a controlled
- 6 variable for said mechanism in a predetermined cycle;
- 7 a simulation unit, in which said mechanism is
- 8 configured as a virtual model, for simulating, in a
- 9 predetermined cycle which is set shorter than said
- 10 predetermined control cycle, an operation of said
- 11 mechanism for a time corresponding to said
- 12 predetermined control cycle, by using said model, to
- 13 calculate and output a state variable of said
- 14 mechanism;
- 15 a holding unit, arranged between said control
- 16 program execution unit and said simulation unit, for
- 17 temporarily holding said controlled variable from said
- 18 control program execution unit to transfer said
- 19 controlled variable to said simulation unit, whereas
- 20 temporarily holding said state variable from said
- 21 simulation unit to transfer said state variable to said
- 22 control program executing unit; and
- 23 a simulation control unit for making said
- 24 simulation unit shift to a state of waiting for a
- 25 response from said control program execution unit and

26 making said control program execution unit initiate
27 an operation of calculating a controlled variable
28 according to said state variable when said state
29 variable from said simulation unit is held in said
30 holding unit, whereas making said control program
31 execution unit shift to a state of waiting for a response
32 from said simulation unit and making said simulation
33 unit initiate a simulating operation according to said
34 controlled variable when said controlled variable from
35 said control program execution unit is held in said
36 holding unit.

1 2. A control program development support apparatus
2 comprising:

3 a control program execution unit for executing
4 a control program, which controls an operation of a
5 servo mechanism, to calculate and output a controlled
6 variable for said servo mechanism in a predetermined
7 control cycle;

8 a simulation unit, in which said servo
9 mechanism is configured as a virtual model, for
10 simulating, in a predetermined simulation cycle which
11 is set shorter than said predetermined control cycle,
12 an operation of said servo mechanism for a time
13 corresponding to said predetermined control cycle,
14 while dynamically analyzing the operation of said servo
15 mechanism by using said model, to calculate and output

16 a state variable of said servo mechanism;
17 a holding unit, arranged between said control
18 program execution unit and said simulation unit, for
19 temporarily holding said controlled variable from said
20 control program execution unit to transfer said
21 controlled variable to said simulation unit, whereas
22 temporarily holding said state variable from said
23 simulation unit to transfer said state variable to said
24 control program executing unit; and

25 a simulation control unit for making said
26 simulation unit shift to a state of waiting for a
27 response from said control program execution unit and
28 making said control program execution unit initiate
29 an operation of calculating a controlled variable
30 according to said state variable when said state
31 variable from said simulation unit is held in said
32 holding unit, whereas making said control program
33 execution unit shift to a state of waiting for a response
34 from said simulation unit and making said simulation
35 unit initiate a simulating operation according to said
36 controlled variable when said controlled variable from
37 said control program execution unit is held in said
38 holding unit.

1 3. The control program development support apparatus
2 according to claim 2 further comprising a synchronous
3 setting means for performing synchronous setting of

4 said simulation control unit.

1 4. The control program development support apparatus
2 according to claim 3, wherein said synchronous setting
3 means is configured using a graphical user interface
4 function.

1 5. The control program development support apparatus
2 according to claim 2, wherein said control program
3 execution unit outputs a plurality of controlled
4 variables to be inputted to said simulation unit at
5 different timings during one control cycle; and
6 said control program development support
7 apparatus further comprises a multi-rate control means
8 for performing an input control on said plural
9 controlled variables such that said controlled
10 variables are inputted to said simulation unit at
11 respective predetermined timings.

1 6. The control program development support apparatus
2 according to claim 5 further comprising a multi-rate
3 setting means for performing setting of said multi-rate
4 control means.

1 7. The control program development support apparatus
2 according to claim 6, wherein said multi-rate setting
3 means is configured using a graphical user interface

4 function.

1 8. The control program development support apparatus
2 according to claim 2, wherein said simulation control
3 unit determines a timing, at which said control program
4 execution unit starts calculating said controlled
5 variable, on the basis of a result of simulation by
6 said simulation unit.

1 9. The control program development support apparatus
2 according to claim 2, wherein said model is configured
3 with a plurality of parts of which operations can be
4 separately simulated; and
5 said simulation unit comprises a plurality of
6 processors for simulating in parallel the operations
7 of said plural parts.

1 10. The control program development support apparatus
2 according to claim 2, wherein said holding unit
3 comprises:
4 a plurality of registers for temporarily
5 holding data including said controlled variable to be
6 transferred from said control program execution unit
7 to said simulation unit and said state variable to be
8 transferred from said simulation unit to said control
9 program execution unit;
10 a first write/read control unit for

11 controlling writing/reading of said data between said
12 plural registers and said control program execution
13 unit; and

14 a second write/read control unit for
15 controlling writing/reading of said data between said
16 plural registers and said simulation unit.

1 11. The control program development support apparatus
2 according to claim 10, wherein an interrupt signal,
3 which is inputted to one of said plural registers from
4 said simulation unit in order to make said control
5 program execution unit initiate the operation of
6 calculating said controlled variable, is directly sent
7 from said register to said control program execution
8 unit without reference to said first write/read control
9 unit.

1 12. The control program development support apparatus
2 according to claim 10 further comprising a data display
3 unit for displaying data held in said plural registers.

1 13. The control program development support apparatus
2 according to claim 12 further comprises a selecting
3 unit for selecting at least one register from said
4 plural registers to make said data display unit display
5 data held in said selected register.

1 14. The control program development support apparatus
2 according to claim 12, wherein said data display unit
3 is directly connected to a specific register among said
4 plural registers to display data held in said specific
5 register.

1 15. The control program development support apparatus
2 according to claim 10 further comprises a data input
3 unit for forcedly setting and storing desired data in
4 at least one of said plural registers.

1 16. The control program development support apparatus
2 according to claim 15, wherein said data input unit
3 is directly connected to a specific register among said
4 plural registers to set said desired data in said
5 specific register.

1 17. The control program development support apparatus
2 according to claim 1 further comprises a noise
3 superposing unit for superposing noise on data read
4 out from at least one of said plural registers.